Appendix 10-1: Analysis of Control Strategies And Determination of Reasonable Progress Goals

APPENDIX 10-1: ANALYSIS OF CONTROL STRATEGIES AND DETERMINATION OF REASONABLE PROGRESS GOALS

10-1.1 IDENTIFICATION OF KEY POLLUTANTS

Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals* demonstrates that NO_x and SO_2 are the main anthropogenic pollutant emissions that affect visibility at Class I areas in Texas and in neighboring states. Table 1 summarizes the percentage contribution of various pollutants at the Texas Class I areas and those Class I areas in other states that PSAT modeling indicates receive more than 20 percent of their visibility impairing haze from Texas emissions in the 2002 base case modeling.

Table 1: Pollutant Impacts on Visibility at the Class I Areas with a 20 Percent or Greater Impact from Texas Emissions

Source	BIBE*	GUMO*	WIMO*	SACR*	WHIT*
SO_4	49.7	57.7	54.7	43.2	52.9
NO_3	4.4	10.2	22.5	26.1	14.7
POA	16.4	6.1	6.2	8.2	7.1
EC	9.1	6.6	5.3	7.4	7.4
Soil	6.7	6.8	4.6	6.0	6.8
CM	7.1	4.0	3.8	2.9	1.8
SOAA	1.9	2.7	1.4	2.2	3.4
SOAB	4.6	5.8	1.5	4.1	5.9

* Big Bend, Guadalupe Mountains, Wichita Mountains, Salt Creek, and White Mountain areas

As the table indicates, sulfur dioxide (SO_2) emissions, which form sulfate (SO_4), are clearly the most important contributor to visibility impairment at these Texas-impacted Class I areas. In every case except for Big Bend, nitrate (NO_3), which forms from NO_X emissions is the second most important pollutant.

The situation at Big Bend is less clear, as shown in Table 2 shows.

Table 2: Source Categories Contributing to Regional Haze at Big Bend National Park

Source	Elevated Point	Low Level Point	Natural	On Road	Non Road	Area	IC	BC	SOAA	SOAB	total
SO_4	32.0	1.3	0.0	0.5	0.8	3.4	0.0	11.5			49.7
NO_3	1.1	0.1	0.7	0.8	0.5	0.6	0.0	0.6			4.4
POA	0.3	0.0	0.2	0.1	0.3	2.5	0.0	13.0			16.4
EC	0.0	0.0	0.1	0.4	1.4	1.9	0.0	5.2			9.1
SOIL	0.7	0.1	3.0	0.0	0.0	2.7	0.0	0.3			6.7
CM	0.0	0.0	5.6	0.0	0.1	1.2	0.0	0.2			7.1
SOAA									1.9		1.9
SOAB										4.6	4.6

After sulfur, Primary Organic Aerosols (POA) constitutes the next biggest source of impairment at Big Bend; however, the vast majority of POA is from the model's boundary conditions (BC), which include southern Mexico and Central and South America. Therefore, this source is not controllable by Texas. Elemental carbon (EC) is also dominated by the boundary conditions. The next two sources, soil and coarse mass (CM), are most likely from natural dust storm events. For these reasons, even at Big Bend, NO_3 becomes the second most important pollutant for Texas to consider in its regional haze SIP.

10-1.2 IDENTIFICATION OF SOURCES FOR CONTROL

Once the main types of pollutants affecting visibility in Texas-impacted Class I areas have been determined, the next step is to determine what kinds of sources emit these pollutants. That is, should the control strategy focus on point sources only or should area sources and mobile sources be considered as well? Table 3 shows the sources of these pollutants in the 2002 base case PSAT modeling for the two Class I areas in Texas. The numbers are in percentages. For example, 67.1 percent of the SO_4 impacting Big Bend can be attributed to point sources.

Table 3: Source Category Contributions to SO_4 and NO_3 at the Five Class I Areas Texas Affects the Most (by percent)

	Big Bend			Guadalupe Mountains		
	Point	**Mobile**	**Area**	**Point**	**Mobile**	**Area**
SO_4	67.1	2.8	6.9	75.6	3.5	8.5
NO_3	26.6	28.6	14.3	29.2	36.5	13.9

	Wichita Mountains			Salt Creek			White Mountain		
	Point	**Mobile**	**Area**	**Point**	**Mobile**	**Area**	**Point**	**Mobile**	**Area**
SO_4	78.2	3.7	9.2	73.8	3.9	8.1	75.2	4.1	8.1
NO_3	28.1	44.7	13.4	35.8	29.9	17.1	27.9	40.3	12.0

As Table 3 shows, sulfur emissions affecting visibility in the Class I areas are clearly dominated by point sources. The mobile source contribution will be reduced as much as feasible through federal fuel sulfur rules already on the books. As for area source sulfur, the TCEQ has significant concerns about the emissions inventory accuracy. For example, the CENRAP inventory for area source sulfur compound emissions is more than seven times higher than the TCEQ estimate for that category. For this reason, our control strategy analysis will focus on point sources of sulfur compounds.

Nitrogen oxide emissions are more evenly distributed among point, mobile, and area sources. As described in Chapters 10 and 11, Texas is already going well beyond the federal requirements to reduce both on-road and non-road mobile emissions. Furthermore, the states have very limited authority to reduce mobile source emissions. Control of mobile source NO_X emissions is principally a federal responsibility. Area source NO_X is of concern to Texas both for our ozone SIP and for the Regional Haze SIP. The biggest source of area source NO_X is upstream oil and gas production. The TCEQ is taking all steps it has determined are reasonable at this time to control these sources in the Dallas-Fort Worth ozone SIP. In addition, the State of Texas is investing $4,000,000 in a grant program to assist with the retrofitting of gas-fired, rich burn compressor engines[1]. The TCEQ will continue its research analysis of emissions from oil and gas production. We will re-examine these sources in the five-year update of the Regional Haze SIP. By that time, we expect to have much improved information on the inventory and the economic and technical feasibility of additional controls. Given these considerations, the TCEQ decided to focus on point sources of NO_X when considering additional controls to improve visibility at Class I areas. It is important to note that Texas has already implemented substantial controls on point source NO_X as part of its ozone SIPs. These are described in more detail in Chapter 11: Long Term Strategy.

10-1.3 SELECTION OF SOURCES FOR POSSIBLE ADDITIONAL CONTROLS

Having narrowed the scope of the review to point sources of SO_2 and NO_X, the next step is to develop a high-level estimate of the costs and reductions associated with a set of potentially reasonable additional controls to reduce regional haze. The TCEQ developed a set of possible controls focusing on sources that had the potential to affect visibility at Class I areas and that had the least costly available controls on a cost per ton basis. The CENRAP conducted a large-scale study of control options using the EPA's AirControlNet Model. This study served as the basis for the Texas analysis.

[1] http://www.tceq.state.tx.us/implementation/air/sip/sb2003.html

The CENRAP used the latest revised version of the U.S. EPA's AirControlNet model to analyze potential add-on control device strategies for appropriate emissions generating units (Alpine 2007). AirControlNet is a PC-based database tool for conducting pollutant emissions control strategy and cost analysis. The study overlaid a detailed EPA control measure database on CENRAP's emissions inventories to compute source- and pollutant-specific emission reductions and associated costs at various geographic levels. For Texas, the 2002 Texas point source emissions inventory was the basis for the analysis.

The potential strategies, estimated capital costs, and costs per ton reduced were summarized and distributed to each of the CENRAP states. In many cases more than one strategy was proposed for a type of unit. In these cases, the least costly control, on a dollar per ton cost basis, was assumed to be implemented first, with the incremental cost of adding the additional strategy included. In addition to the CENRAP proposed controls, TCEQ added flue gas desulfurization as a potential control for nine units at three carbon black plants.

The best candidate sources for proposed control strategies were identified with a two step process. First, sources with potential control strategy costs greater than $2,700 per ton SO_2 for NO_X were initially screened out to limit the population to potential sources with relatively cost effective control strategies. The group of sources was further reduced to eliminate sources that are so distant from any of the ten Class I areas that any reduction in emissions would be unlikely to have a perceptible impact on visibility. The list was restricted to those sources with a ratio of estimated projected 2018 base annual emissions (tons) to distance (kilometers) greater than five to any Class I area. Also, any source with predicted 2018 emissions less than 100 tons per year was excluded. The regulatory and logistical overhead associated with controlling these small sources would not be justified by the likely benefit.

The TCEQ also excluded additional NO_X controls on cement kilns from consideration since the TCEQ has already required all the measures it has determined are reasonable to control NO_X emissions from these sources in the latest Dallas-Fort Worth ozone SIP revision. A study performed for the SIP (July 2006, a report entitled "Assessment of NO_X Emissions Reduction Strategies for Cement Kilns) evaluated the applicability, availability and cost effectiveness of potential NO_X control technologies for the ten cement kilns located at three Ellis County sites. The report focused on selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and low temperature oxidation (LoTOx). Based on the results of the study, the TCEQ conducted modeling sensitivity analyses at two levels of control to evaluate potential ozone reduction benefits from possible cement kiln control strategies. One modeling sensitivity assumed a range of 35 to 50 percent NO_X control on cement kilns depending upon kiln type; the second assumed a range of 80 to 85 percent. After reviewing the report of the kiln study, the modeling sensitivity results, and all other available information, the TCEQ determined that the 35 to 50 percent control range was the most appropriate control level. The TCEQ develop a source cap that will require a reduction of approximately 9.69 tpd of NO_X emissions from the cement kilns in Ellis County starting March 2009. The source cap approach does not require a specific technology, but provides flexibility for kiln operators to comply in the most effective, technically sound, and expeditious manner possible, while forcing sizeable NO_X emission reductions from all cement kilns in the area. In most cases, the commission anticipates that the limitations will be attainable with SNCR and will not require costly and time consuming research and development of other technologies. Pilot testing of SNCR on wet and dry kilns in 2006 demonstrated that 30 to 40 percent reductions were achievable without hazardous by-product formation. Finally, before an increase in NO_X emissions from a change in operation from one unit of the installation

of new kiln could occur, a corresponding and equivalent decrease in NO_X emissions would be required from another existing unit.

This analysis relied on the CENRAP estimates of control costs and feasibility. The costs presented in this study are estimates based on categories of units. A site-specific analysis would be necessary to determine actual costs and whether a particular control device is not feasible at a particular unit due to physical or process constraints.

10-1.4 PROPOSED CONTROLS

The types of industry and controls considered are listed below. These controls would go beyond what is already expected due to the Clean Air Interstate Rule (CAIR), BART controls planned for ozone SIPs.

- SO_2 control at 24 facilities from 15 sites
  - Natural Gas Transmission - flue gas desulfurization (FGD)
  - Crude Petroleum - Sulfur recovery and/or tail gas treatment
  - Inorganic chemical plants - coal washing and spray dryer absorber (SDA) on boilers, increase efficiency of sulfuric acid plants
  - Electric Generating Units (EGU) - coal washing and FGD wet scrubbing
  - Carbon black – FGD

- NO_X control for 24 facilities at 15 sites
  - Natural Gas Transmission- Low NO_X burners (LNB), SCR + LNB
  - EGU - LNB with close coupled over-fired air (LNC1), and with both close-coupled and separated over-fired air (LNC3)
  - Flat Glass - LNB, SCR
  - Paper Mills SNCR and oxygen trim (OT) with water injection
  - Chemical Plant Boiler - selective catalytic reduction (SCR)

Tables 6 through 10 provide details on the sources, costs, and control results expected from the set of point source controls considered to determine whether they are reasonable. Table 4 below summarizes the cost and emissions reductions expected from this analysis. Table 5 provides the estimated visibility improvement for each Class I. The basis for this estimate is provided in Appendix 10-2.

Table 4: Summary of Additional Point Source Controls Considered for Reasonableness

Pollutant	Tons Per Year Reduced	Estimated Annualized Cost ($2005)
Sulfur Dioxide	155,873	$270,800,000
Nitrogen Oxides	27,132	$53,500,000
Total Costs		$324,300,000

Table 5: Estimated Haze Index Improvements for Affected Class I Areas From Additional Controls

Class 1	**Big Bend**	**Breton Isle**	**Caney Creek**	**Carlsbad Caverns**	**Guadalupe Mountains**
HI Improvement (deciview)	0.16	0.05	0.33	0.22	0.22
Class 1	**Salt Creek**	**Upper Buffalo**	**Wheeler Peak**	**White Mountain**	**Wichita Mountains**
HI Improvement (dv)	0.18	0.16	0.04	0.24	0.36

As explained in Chapter 10, the TCEQ has determined that it is not reasonable to pursue additional controls at this time. The control set defined in this appendix yielded too little benefit for the cost.

10-1.5 Area of Influence Determination

To determine Texas' apportioned contribution to measured 2002 and predicted 2018 visibility extinction and impact of proposed controls, the area of influence (AOI) curves developed for CENRAP were used as a starting point. Working at CENRAP's direction, Alpine Geophysics (Alpine, 2006) used Residence Time Difference plots (DRI, 2005c), the Probability of Regional Source Contribution to Haze (PORSCH) plots (Raffuse *et al*., 2005), the Tagged Species Source Apportionment (TSSA) results (Tonnesen and Wang, 2004; UCR, 2006), and engineering judgment to construct a consistent set of AOIs for each area.

The Residence Time Difference (RTD) plots are based on the Back Trajectory Residence Time (BTRT) plots. Back trajectory analyses use meteorological fields to estimate the geographical path an air mass traversed to end at a particular receptor. The Desert Research Institute (DRI) (2005b) developed the BTRT estimates used in this study by employing the NOAA HYSPLIT back trajectory model (Draxler and Hess, 1997; NOAA, 2006). BTRT plots give the fraction of total hours that an air parcel resided over each specific geographical area. The RTD plots for each pollutant come from by subtracting the map for all days at a site from the map for the 20 percent worst days for the respective pollutant pollutant. This process produced RTD plots for the twenty percentile worst sulfate, nitrate, organic carbon, elemental carbon, fine soil, and coarse mass days for each area CENRAP considered. The RTD maps show the areas that air was over more frequently (positive numbers) on worst case days compared to all days.

The PORSCH system is a suite of GIS tools that combines modeled backward wind trajectories, monitored concentrations, meteorological conditions, and emissions estimates to estimate probable regions of influence. PORSCH combines ensemble backward trajectories with chemically speciated emissions data to estimate the trajectory-emissions density-weighted area that is likely to affect a receptor site. PORSCH can do this for a single day or a suite of days. This study used only data relevant to the 20 percent worst haze days.

As the name implies Tagged Species Source Apportionment (TSSA) uses "Tagged Chemical Species," or tracers, to track chemical transformations and transport of each chemical species or

precursor species during an air quality model run. Key chemical species are identified. These tagged chemical species for specific emissions source regions and source categories are tracked during all phases of the air quality modeling run. The end results show the sources contributing to the final chemical species for any grid cell in model domain.

Because RTD plots were available for the entire suite of twenty-one areas, they served as the primary basis from which Alpine produced the AOIs. Alpine examined the RTD plots for each area and each pollutant to identify "break points" between the most significant and lower level areas of influence contributing to the high concentrations of each pollutant. Alpine examined the PORSCH and TSSA results to refine the area of influence contours. Alpine then compared the Level 1 areas of influence for the different pollutants for each area and for nearby areas to determine whether the Level 1 areas of influence could be combined for pollutants and for nearby areas. Alpine repeated the process for Level 2 and further level AOIs. This process produced the AOIs the TCEQ has used in developing the list of sources and four-factor analysis used to determine whether additional controls on Texas sources are reasonable to reduce the visibility impact of Texas' emissions on each area they affect.

The TCEQ used the second order of influence for ten Class I areas within Texas and adjoining states to define the geographic area of concern for significant NO_X and SO_2 emitting sources. The Class I areas considered were Caney Creek, Carlsbad Caverns, Big Bend, Guadalupe Mountains, Salt Creek, Upper Buffalo, Wheeler Peak, White Mountain, and Wichita Mountains. The population of sources determined from the entire state was apportioned to each Class I based on these curves. This list of sources for each Class I area was sent to appropriate state as part of the consultation process. This correspondence and lists of sources are in Appendix 4-3.

Table 6: Proposed SO_2 Controls Based on CENRAP Modeling

Acct No	FIN	Source Type for Control	Control Measure	2018 Base Case SO2 -- Tons	Cntrl -- Tons Reduced	Cntrl -- CE (%)	Controls -- Annualized Cost ($2005)	Controls -- Cost Per Total Ton Reduced	Qbase /5d
BG0057U	BOILER1	Utility Boilers - Coal-Fired	Coal Washing	10,836	3,793	35	$1,824,685	$481	4.93
BG0057U	BOILER1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	10,836	9724	90	$25,000,104	$2,564	4.93
BG0057U	BOILER2	Utility Boilers - Coal-Fired	Coal Washing	10,658	3,730	35	$1,794,818	$481	4.85
BG0057U	BOILER2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	10,658	9,593	90	$25,000,104	$2,606	4.85
CG0012C	INCIN	Tail Gas Incinerator	FGD	1,328	1,195	90	$1,703,960	$1,425	2.00
FI0020W	B1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	23,142	20,828	90	$32,766,310	$1,573	13.77
FI0020W	B2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	23,641	21,277	90	$32,766,310	$1,540	14.07
GF0002R	B-1	Utility Boilers - Coal-Fired	Coal Washing	16,096	5,634	35	$2,710,461	$481	5.82
GF0002R	B-1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	16,096	14,486	90	$36,014,449	$2,486	5.82
GH0004O	BLR0009A01	Bituminous/Sub-bituminous Coal (Industrial Boilers)	SDA	1,960	1,764	90	$4,687,674	$2,658	1.76
GH0004O	BLR0010A01	Utility Boilers - Coal-Fired	Coal Washing	1,160	406	35	$195,408	$481	1.04
HG0659W	H600	Cat Cracker Heater	FGD	5,491	4,942	90	$8,474,217	$1,715	2.09

Acct No	FIN	Source Type for Control	Control Measure	2018 Base Case SO2 -- Tons	Cntrl -- Tons Reduced	Cntrl -- CE (%)	Controls -- Annualized Cost ($2005)	Controls -- Cost Per Total Ton Reduced	Qbase /5d
HG0697O	PIR-2	Sulfuric Acid Plants - Contact Absorber (98% Conversion)	Increase % Conversion to Meet NSPS (99.7)	4,101	3,486	85	$670,008	$192	1.55
HG0697O	U-8	Sulfuric Acid Plants - Contact Absorber (98% Conversion)	Increase % Conversion to Meet NSPS (99.7)	7,005	5,954	85	$2,510,927	$422	2.65
HR0018T	H-8*	Sulfur Plant Incinerator	FGD	3,590	3,231	90	$6,865,014	$2,124	3.60
RF0009N	INCIN-COMB	Incinerator	FGD	4,059	3,653	90	$8,153,168	$2,232	5.25
TF0013B	B1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	19,144	17,230	90	$32,196,462	$1,869	23.06
TF0013B	B2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	19,695	17,725	90	$32,196,462	$1,816	23.73

*Unit Planned Shutdown March 2007

Table 7: Location and Program Status Details For Emission Units With CENRAP Proposed SO_2 Controls

County	Acct No	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	BOILER1	No	Yes	Electric Services	Big Bend	440
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	BOILER2	No	Yes	Electric Services	Big Bend	440
Cass	CG0012C	Enbridge	BRYANS MILL PLANT	INCIN	No	No	Nat'l Gas Liq	Caney Creek	133
Freestone	FI0020W	TXU	BIG BROWN	B1	No	Yes	Electric Services	Caney Creek	336
Freestone	FI0020W	TXU	BIG BROWN	B2	No	Yes	Electric Services	Caney Creek	336
Goliad	GF0002R	AEP	COLETO CREEK PLANT	B-1	No	Yes	Electric Services	Big Bend	553
Gray	GH0004O	Celanese	CHEMICAL MANUFACTURING	BLR0009A01	Yes	No	Industrial Organic Chemicals	Wichita Mtns	222
Gray	GH0004O	Celanese	CHEMICAL MANUFACTURING	BLR0010A01	Yes	No	Industrial Organic Chemicals	Wichita Mtns	222
Harris	HG0659W	Shell	DEER PARK PLANT	H600	Yes	No	Petroleum Refining	Caney Creek	526
Harris	HG0697O	Rhodia	HOUSTON PLANT	PIR-2	Yes	No	Industrial Inorganic Chemicals	Caney Creek	529
Harris	HG0697O	Rhodia	HOUSTON PLANT	U-8	Yes	No	Industrial Inorganic Chemicals	Caney Creek	529
Hopkins	HR0018T	Valence	COMO PLT	H-8	No*	No	Nat'l Gas Liq	Caney Creek	199
Reeves	RF0009N	El Paso Natr'l Gas	WAHA PLANT	INCIN-COMB	No	No	Natural Gas Transmission	Carlsbad	155
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B1	No	Yes	Electric Services	Caney Creek	166
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B2	No	Yes	Electric Services	Caney Creek	166

* site was exempted for BART

Table 8: Proposed SO_2 Control For Carbon Black Units

County	Acct No.	Company	Site	FIN	BART	Description	2018 Base Case SO2 (tons)	Control Measure	Cntrl CE (%)	Cntrl – Tons Reduced	dist. (km)	Nearest	Qbase/ 5d
Howard	HT0027B	Sid Richard-son	BIG SPRING	PR1002	No	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Howard	HT0027B	Sid Richard-son	BIG SPRING	DRYER22	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard-son	BIG SPRING	PR1004	No	MAIN PROCESS VENT,CO BOILER, INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Howard	HT0027B	Sid Richard-son	BIG SPRING	DRY1006	Yes	PELLET DRYER	1,790	FGD	80	1,432	295	Carlsbad	1.2
Howard	HT0027B	Sid Richard-son	BIG SPRING	DRYER24	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard-son	BIG SPRING	DRYER23	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard-son	BIG SPRING	PR1007	Yes	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Hutchin-son	HW0017R	Sid Richard-son	BORGER	B119N	No	INDUSTRIAL NATURAL GAS 10-100MMBTU/HR	4,262	FGD	80	3,410	238	Wichita Mtns	3.6
Orange	OC0020R	Degussa	ECHO	I-1	No	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,354	FGD	80	2,683	430	Breton Isle	1.6
						Total				20,350			

Table 9: Proposed NO_X Controls Based on CENRAP Modeling

Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NOx (Tons)	Control -- Tons Reduced	Controls -- CE (%)	Controls -- Annualized Cost ($2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
BG0057U	SOMMERS DEELY SPRUCE PWR	P-5	Utility Boiler - Coal/Tangential	LNC1	2,431	1,052	43.3	$813,312	$773	1.11
BG0057U	SOMMERS DEELY SPRUCE PWR	P-5	Utility Boiler - Coal/Tangential	LNC3	2,431	1,417	58.3	$1,400,066	$988	1.11
CG0010G	TEXARKANA MILL	PB02	ICI Boilers - Wood/Bark/Stoker - Large	SNCR - Urea Based	824	453	55	$907,290	$2,001	1.33
CG0010G	TEXARKANA MILL	RB02	Sulfate Pulping - Recovery Furnaces	OT + WI	822	535	65	$368,011	$689	1.32
C20005I	GUADALUPE COMPRESSOR STATION	C-1	Combustion Turbines - Natural Gas	Dry Low NOx Combustor	850	714	84	$153,587	$215	26.34
C20005I	GUADALUPE COMPRESSOR STATION	C-1	Combustion Turbines - Natural Gas	SCR + LNB	850	799	94	$1,031,230	$1,291	26.34
FC0018G	FAYETTE POWER PROJECT	3-1B	Utility Boiler - Coal/Tangential - POD10	LNC3	2,764	843	58.3	$1,049,562	$1,245	1.00
FI0020W	BIG BROWN	B1	Utility Boiler - Coal/Tangential	LNC3	3,574	593	58.3	$1,518,941	$2,560	2.13
FI0020W	BIG BROWN	B2	Utility Boiler - Coal/Tangential	LNC3	3,725	618	58.3	$1,518,941	$2,456	2.22
GH0003Q	PAMPA PLANT	P-1KATUINC	Indust. Incinerators	SNCR	1,230	553	45	$1,345,248	$2,431	1.11
GH0004O	CHEMICAL MANUFACTUR	BLR0009A01	ICI Boilers - Coal/Wall	SNCR	1,277	511	40	$923,371	$1,807	1.15
GH0004O	CHEMICAL MANUFACTUR	BLR0009A01	ICI Boilers - Coal/Wall	SCR	1,277	1,150	90	$2,646,447	$2,302	1.15

Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NOx (Tons)	Control -- Tons Reduced	Controls -- CE (%)	Controls -- Annualized Cost ($2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
LB0047N	TOLK STATION	UNIT 1	Utility Boiler - Coal/Tangential	LNC3	2,698	823	58.3	$1,426,484	$1,733	3.03
LB0047N	TOLK STATION	UNIT 2	Utility Boiler - Coal/Tangential - POD10	LNC3	2,510	766	58.3	$1,426,484	$1,863	2.82
LI0027L	RELIANT ENERGY LIMESTONE	1	Utility Boiler - Coal/Tangential - POD10	LNC3	5,703	1,739	58.3	$2,208,408	$1,270	2.97
LI0027L	RELIANT ENERGY LIMESTONE	2	Utility Boiler - Coal/Tangential - POD10	LNC3	5,117	1,561	58.3	$2,023,493	$1,297	2.67
MM0023J	SANDOW STEAM ELECTRIC	S4MB	Utility Boiler - Coal/Tangential - POD10	LNC3	5,509	914	58.3	$1,439,691	$1,574	2.27
NB0014R	GUARDIAN INDUSTRIES	01002	Flat Glass Manufacturing	LNB	2,796	1,118	40	$1,684,527	$1,506	1.67
NB0014R	GUARDIAN INDUSTRIES	01002	Flat Glass Manufacturing	SCR	2,796	2,097	75	$3,203,608	$1,528	1.67
PG0041R	HARRINGTON STATION	UNIT 1	Utility Boiler - Coal/Tangential	LNC3	1,779	543	58.3	$876,960	$1,616	1.28
PG0041R	HARRINGTON STATION	UNIT 2	Utility Boiler - Coal/Tangential	LNC3	1,912	583	58.3	$902,072	$1,547	1.38
PG0041R	HARRINGTON STATION	UNIT 3	Utility Boiler - Coal/Tangential	LNC3	1,845	563	58.3	$902,072	$1,603	1.33
RL0020K	MARTIN LAKE	U1-B1	Utility Boiler - Coal/Tangential	LNC3	8,516	1,414	58.3	$1,981,227	$1,401	7.12
RL0020K	MARTIN LAKE	U2-B2	Utility Boiler - Coal/Tangential	LNC3	5,251	872	58.3	$1,981,227	$2,273	4.39
RL0020K	MARTIN LAKE	U3-B3	Utility Boiler - Coal/Tangential	LNC3	5,105	847	58.3	$1,981,227	$2,338	4.26

Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NOx (Tons)	Control -- Tons Reduced	Controls -- CE (%)	Controls -- Annualized Cost ($2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
TF0013B	MONTICELLO	B2	Utility Boiler - Coal/Tangential	LNC3	4,553	756	58.3	$1,492,524	$1,975	5.48
WH0040R	WORKS NO 4	STA-22	Flat Glass Manufacturing	LNB	4,733	1,893	40	$2,851,572	$1,506	11.84
WH0040R	WORKS NO 4	STA-22	Flat Glass Manufacturing	SCR	4,733	3,550	75	$5,423,079	$1,528	11.84
WH0040R	WORKS NO 4	STA-23	Flat Glass Manufacturing	LNB	4,192	1,677	40	$2,525,375	$1,506	10.49
WH0040R	WORKS NO 4	STA-23	Flat Glass Manufacturing	SCR	4,192	3,144	75	$4,802,723	$1,528	10.49
				Totals				$ 54,267,839		

Table 10: Location and Program Status Details For Emission Units With Proposed NO_X Controls

County	Account	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	P-5	No	Yes	Electric Services	Big Bend	440
Cass	CG0010G	IP	TEXARKANA MILL	PB02	Yes	No	Paper Mills	Caney Creek	124
Cass	CG0010G	IP	TEXARKANA MILL	RB02	Yes	No	Paper Mills	Caney Creek	124
Culberson	C20005I	EL PASO NATRL GAS	GUADALUPE COMPRESSOR STATION	C-1	No	No	Natural Gas Transmission	Guadalupe Mtns	6
Fayette	FC0018G	LCRA - Seymour	FAYETTE POWER PROJECT	3-1B	No	Yes	Electric Services	Caney Creek	554
Freestone	FI0020W	TXU	BIG BROWN	B1	No	Yes	Electric Services	Caney Creek	336
Freestone	FI0020W	TXU	BIG BROWN	B2	No	Yes	Electric Services	Caney Creek	336
Gray	GH0003Q	Cabot	PAMPA PLANT	P-1KATUINC	Yes	No	Carbon Black	Wichita Mtns	221
Gray	GH0004O	CELANESE	CHEMICAL MANUFACTURING	BLR0009A01	No	No	Industrial Organic Chemicals, NEC	Wichita Mtns	222
Lamb	LB0047N	XCEL	TOLK STATION	UNIT 1	No	Yes	Electric Services	Salt Creek	178
Lamb	LB0047N	XCEL	TOLK STATION	UNIT 2	No	Yes	Electric Services	Salt Creek	178
Limestone	LI0027L	Limestone	RELIANT ENERGY LIMESTONE	1	No	Yes	Electric Services	Caney Creek	384
Limestone	LI0027L	Limestone	RELIANT ENERGY LIMESTONE	2	No	Yes	Electric Services	Caney Creek	384

County	Account	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Milam	MM0023J	TXU	SANDOW STEAM ELECTRIC	S4MB	No	Yes	Electric Services	Wichita Mtns	485
Navarro	NB0014R	GUARDIAN	GUARDIAN INDUSTRIES	01002	No	No	Flat Glass	Caney Creek	334
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 1	No	Yes	Electric Services	Wichita Mtns	278
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 2	No	Yes	Electric Services	Wichita Mountains	278
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 3	No	Yes	Electric Services	Wichita Mountains	277
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U1-B1	No	Yes	Electric Services	Caney Creek Wilderness	239
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U2-B2	No	Yes	Electric Services	Caney Creek	239
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U3-B3	No	Yes	Electric Services	Caney Creek	240
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B2	No	Yes	Electric Services	Caney Creek	166
Wichita	WH0040R	PPG	WORKS NO 4	STA-22	No	No	Flat Glass	Wichita Mtns	80
Wichita	WH0040R	PPG	WORKS NO 4	STA-23	No	No	Flat Glass	Wichita Mtns	80

Acronyms

FGD – flue gas desulfurization
LNB – low NO_X burner
LNC1 - LNB with close-coupled over-fired air (OFA)
LNC2 – LNB with separated OFA
LNC3 – LNB with both close-coupled and separated OFA.
SDA – spray dryer absorber
SCR – selective catalytic reduction
SNCR – selective non-catalytic reduction
OT + WI – oxygen trim plus water injection

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